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PROGRAM EXECUTIVE OFFICE
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IN REPLY REFER TO

PEOTSCINST 5200.3
BT3MS
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PEO TSC INSTRUCTION 5200.3

Subj: VERIFICATION, VALIDATION, AND ACCREDITATION (VV&A) OF MODELING AND SIMULATION (M&S)

Ref: (a) DOD Directive 5000.59
(b) DOD Instruction 5000.61
(c) SECNAVINST 5200.38
(d) SECNAVINST 5200.40
(e) DOD Verification, Validation, and Accreditation (VV&A) Recommended Practices Guide of Nov 96
(f) COMOPTEVFORINST 5000.1
(g) COMOPTEVFOR ltr 3980 Ser 00T/312 of 29 April 98
(h) Modeling and Simulation Accreditation Plan for the Navy Area Theater Ballistic Missile Defense Program of 18 Dec 96
(i) PEOTSCINST 5200.1

Encl: (1) Designation, Execution, and Accreditation Process Templates
(2) Modeling and Simulation Qualification Categories
(3) Levels of Qualification Across the Acquisition Lifecycle
(4) Definitions
(5) Acronym List

1. Purpose. To establish Verification, Validation, and Accreditation (VV&A) policy and provide a consistent framework for the VV&A of Models and Simulations (M&S) used to support program acquisition.

2. Applicability and Scope

a. Applicable to all PEO divisions.

b. All M&S (including hardware-in-the-loop (HWIL/HIL)) sponsored, managed, or used to represent PEO systems and system elements after the effective date of this instruction.

c. The development of other PEO documents as needed to provide VV&A guidance.

d. The establishment of such panels and boards as may be necessary to execute policies, procedures, and plans for VV&A.

3. Background

a. References (a) and (b) direct the establishment of DOD VV&A policies, procedures, and guidelines for M&S applications, standards, and databases managed by the DOD component, and accredit, as appropriate, M&S applications used to support major acquisition decisions. Reference (c) directs the issuance of a common VV&A process for use by Navy and Marine Corps activities. Reference (d) establishes policies and procedures and assigns responsibilities for M&S VV&A requirements within the Department of the Navy (DON). Reference (e) provides information on principles, processes, and techniques recommended for use in DOD VV&A efforts which support program initiatives in the analysis, acquisition, and training communities. Reference (f) promulgates policy and guidance for the development and employment of credible M&S for use in operational testing. Reference (g) establishes policy for accreditation of M&S in support of U.S. Navy Operational Test and Evaluation (OT&E). Reference (h) documents the M&S process used to support MS II decisions by the Navy Area Theater Ballistic Missile Defense (TBMD) Program Office. Updates to this plan for Navy Area MS III and Navy Theater wide programs provided the basis for enclosures (1) and (2). Reference (i) establishes a framework for the management and development of M&S used to support acquisition programs.

b. VV&A refers to the process used to ensure that the application of M&S results is appropriate for a specific purpose, e.g., supporting a system acquisition decision, training a war-fighter, or developing a tactical mission plan. While sometimes referred to as a single process, VV&A contain many processes that address VV&A of M&S. Verification and validation (V&V) functions are performed during the M&S development process and are similar in concept to the application of quality control in manufacturing. Accreditation is a decision to approve the use of specific M&S and its results for a particular application. Properly performed and documented V&V are essential to the accreditation decision process. However, it is equally essential that the Accreditation Authority (AA) understand the scope and limits of specific M&S capabilities before concluding that these M&S results are

applicable and appropriate for the purposes for which they intend to use them.

4. Policy

a. Enclosure (1) establishes a standardized VV&A framework for all M&S used throughout the PEO to improve confidence and credibility in M&S results.

b. Ensure that all efforts needed to verify, validate, and accredit M&S are performed by each contractor and government activity as part of their assigned tasking.

c. Ensure that M&S used to support the major DOD decision-making organizations and processes will be accredited for that application. Likewise, M&S used for joint Analysis of Alternatives (AoA), joint exercises, and joint training will be accredited for that purpose.

d. Ensure Mission Program Managers act as the AA for M&S used by their system processes. In cases where a Mission Program uses a model or simulation developed through the offices of a Product Program, the Mission Program accreditation documentation will cite prior Product Program VV&A and/or qualification documentation. The Mission Program accreditation documentation will also include an assessment of any limitations the Product Program developed M&S may have relative to the Mission Program application. If the application sponsor is a Mission Program Manager or another division of PEO, both will sign accreditation letters with the Product Program Manager.

e. Ensure Product Program Managers act as the AA for M&S used for their major DOD acquisition decision-processes and support other DOD and PEO components to ensure products are represented appropriately.

f. Establish qualification categories for M&S used by Program Offices. Enclosure (2) contains the framework for these qualification categories.

g. Ensure core M&S progressively matures with system design to become an integral part of program lifecycle management, per enclosure (3). At a minimum, identified core M&S will be accredited to support Milestone II, critical DT&E and Milestone III. Accreditation to support critical DT&E should be based on CDR data and conducted well before the first DT event.

5. Responsibilities. PEO TSC is responsible for the execution of all policy within the organization. The Director for Theater Air Missile Defense and Systems Engineering (PEO TSC-T) will provide executive oversight for M&S VV&A guidance, policy, and implementation. To assist in this effort, PEO TSC-T has designated the Director for M&S (PEO TSC-BT3MS) as responsible for coordinating and implementing this policy and to chair the M&S Strategy Council (MSSC). The MSSC will consist of representatives from the Program Offices, the M&S Technical Agent (MSTA), and, as required, field activities, laboratories, and industry.

a. PEO TSC and PEO TSC-T will:

(1) Provide executive oversight on VV&A matters.

(2) Approve VV&A policy and procedures.

b. The PEO Program Managers will:

(1) Serve as the AA for M&S that is accredited for a particular application (OT&E excepted).

(2) Serve as the AA for any M&S whose results are used to support design, development and developmental test (DT) for their program.

(3) The Mission Program Managers, cross-program application sponsors, and the Product Program Managers will share the AA responsibility for mission-level DT and will each sign Accreditation Letters.

(4) Allocate necessary funding to support VV&A activities.

(5) Categorize Program Office M&S for qualification according to the framework per enclosure (2).

(6) Use only M&S accredited with the appropriate level of V&V to support applications, per reference (b).

(7) Ensure core M&S progressively matures with system design and that they become an integral part of lifecycle management, per reference (3).

(8) Establish a senior-level Accreditation Review Panel (ARP) (including PEO TSC-BT3MS) that is responsible for the

overall management of the accreditation process. The ARP will oversee the actions of the technical-level Simulation Control Panels (SCPs) and review the V&V information used to present an accreditation recommendation to the AA.

(9) Establish SCPs that are responsible for providing technical leadership, guiding the gathering of V&V information, providing an independent oversight of the execution of the V&V Plan, and review the V&V efforts of the M&S Proponent (MSP), to include the V&V Report.

(10) Ensure proper execution of the VV&A process, including the M&S designation, V&V execution, and M&S accreditation phases, to meet the minimum requirements in enclosure (1).

(11) Include VV&A status brief at periodic program reviews.

(12) Provide assistance to Commander, Operational Test and Evaluation Force (COMOPTEVFOR), as required, for M&S used to support Operational Testing (OT) and ensuring early COMOPTEVFOR involvement in M&S planning to support OT.

(13) Provide assistance, within resource constraints, to other DOD agencies to support VV&A of simulations used for joint AOA's, joint exercises, or joint training applications.

c. PEO TSC-BT3MS will:

(1) Develop and maintain VV&A guidance and policy documents.

(2) Fund and manage MSTA corporate efforts for PEO initiatives.

(3) Develop POM issues and investment strategies for corporate level initiatives.

(4) Provide systems engineering leadership for VV&A by participating in all ARPs.

(5) Coordinate and assist in defining BMDO and JTAMDO VV&A requirements for PEO systems.

(6) Coordinate VV&A activities within the PEO.

(7) Provide authoritative PEO representation on DON, DOD, JCS and other key VV&A groups.

(8) Develop white papers to promote VV&A initiatives and ensure the dissemination of VV&A lessons-learned.

d. The MSSC will:

(1) Provide program specific VV&A expertise and coordination among programs.

(2) Review and recommend updates to the VV&A instruction.

(3) Support the development of VV&A processes used by Program Offices.

(4) Participate in Navy, DMSO, Joint and other VV&A teams as tasked.

e. The MSTA will report to PEO TSC-BT3MS. The MSTA will support the PEO by advising and assisting in the following areas:

(1) Update the VV&A instruction.

(2) Interface with applicable M&S VV&A activities (e.g., DON, DOD, OSD, and JCS study groups) to ensure that VV&A issues are acknowledged by those organizations.

(3) Develop a coherent M&S VV&A strategy, including coordinated roadmaps and investment strategies.

(4) Review and evaluate DOD and DON architectures, instructions, directives, and standards.

(5) Provide corporate level technical support for the MSSC, including coordinating and facilitating meetings.

(6) Provide information on advances in M&S VV&A technology and best practices available in industry.

(7) Promote and enhance communication and coordination on M&S VV&A issues among Program Offices and between other DOD and DON activities.

6. Definitions and Acronyms. Enclosure (4) defines essential terms. Enclosure (5) lists the abbreviated terms.

7. Review Responsibility. PEO TSC-BT3MS is responsible for the annual review and update of this instruction.

for W. W. COBB, JR.

Distribution:
TSC, B, B1, BA, BA1, BT, BT1, BT2, BT3, BT4, BT5, BT6, BF, BI, BL, BPA, A, BCOS, CIO, CM, CS, E, F, ITF, S, PA, PMS 400B, 400C, 400D, 400G, 410, 422, 429, 451, 452, 456, 461, 465, 467, and 473

DESIGNATION, EXECUTION, AND ACCREDITATION PROCESS TEMPLATES

1. Introduction. Provide a framework for the entire VV&A process and templates that serve as a guide for each of the phases. Modification to the phases of the VV&A process to better serve the individual program as long as the identified functions occur within the modified process.

2. Minimum Requirements. The following are the minimum documentation requirements that must be completed for successful VV&A:

a. A PM approved M&S VV&A Management Plan that addresses the people, processes, and products necessary for VV&A. This plan must include a process for re-accrediting models.

b. Capture cost data for all VV&A activities.

c. For each individual simulation:

(1) Accreditation Plan that includes specific use and acceptance criteria

(2) V&V Plan

(3) Configuration Management (CM) Plan

(4) V&V Report

(5) Accreditation Report

(6) Accreditation Letter

(7) M&S Catalog Entry

3. The VV&A Process. The VV&A process consists of the following three phases:

a. Designation Phase. Begins when the AA designates M&S for VV&A, proceeds with the establishment of an ARP, and culminates with the approval of an Accreditation Plan for the designated M&S. The Accreditation Plan specifies the schedule and resource requirements necessary for completion of the accreditation. Figure 1 below provides a template for the M&S Designation Phase.

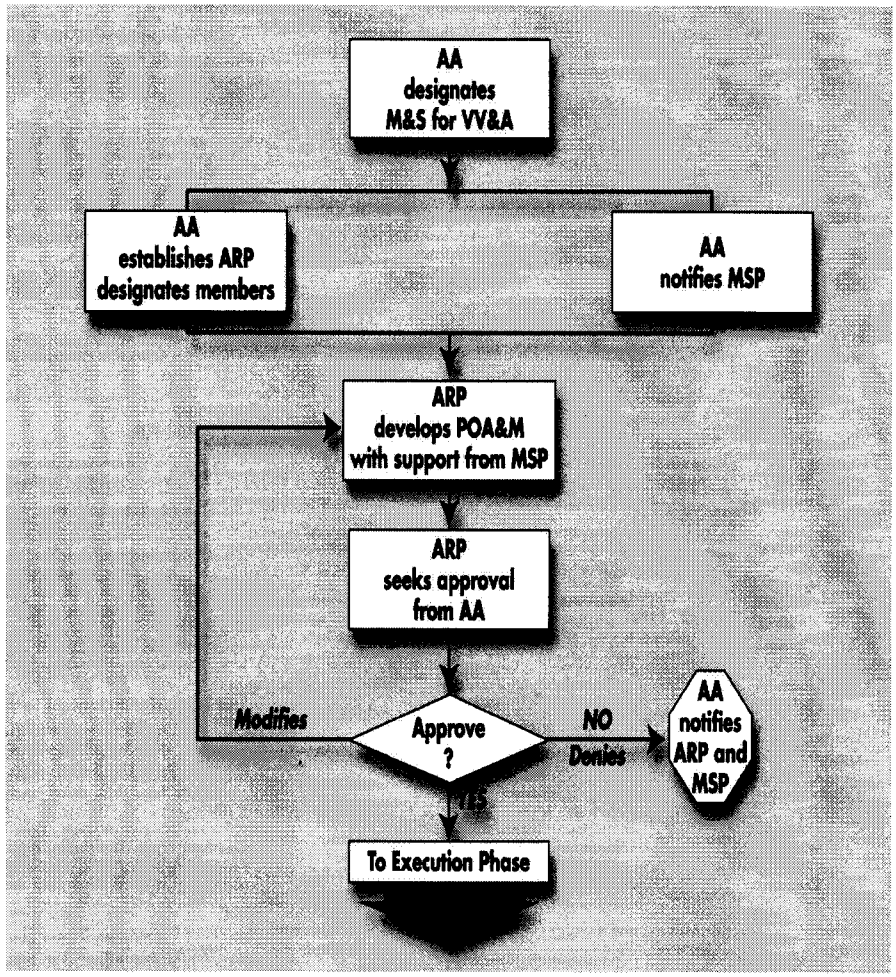

Figure 1: Designation Phase

b. Execution Phase. Begins with the approval of an Accreditation Plan and continues through the development and execution of a V&V Plan. Figure 2 below provides a template for the V&V Execution Phase.

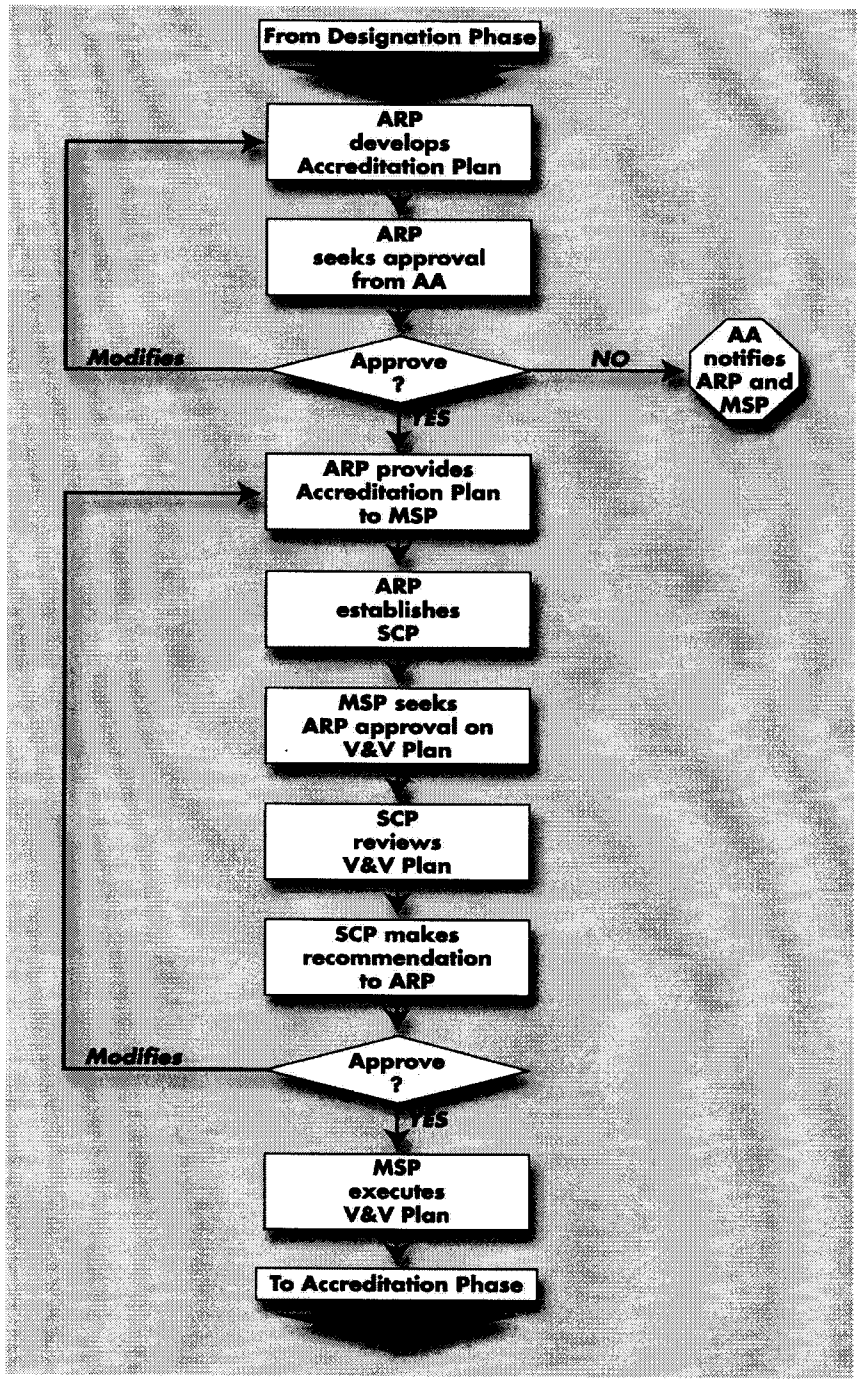

Figure 2: Execution Phase

c. Accreditation Phase. Begins with an ARP review of the V&V Report and is completed when the AA makes the accreditation decision. Figure 3 below provides a template for the M&S Accreditation Phase.

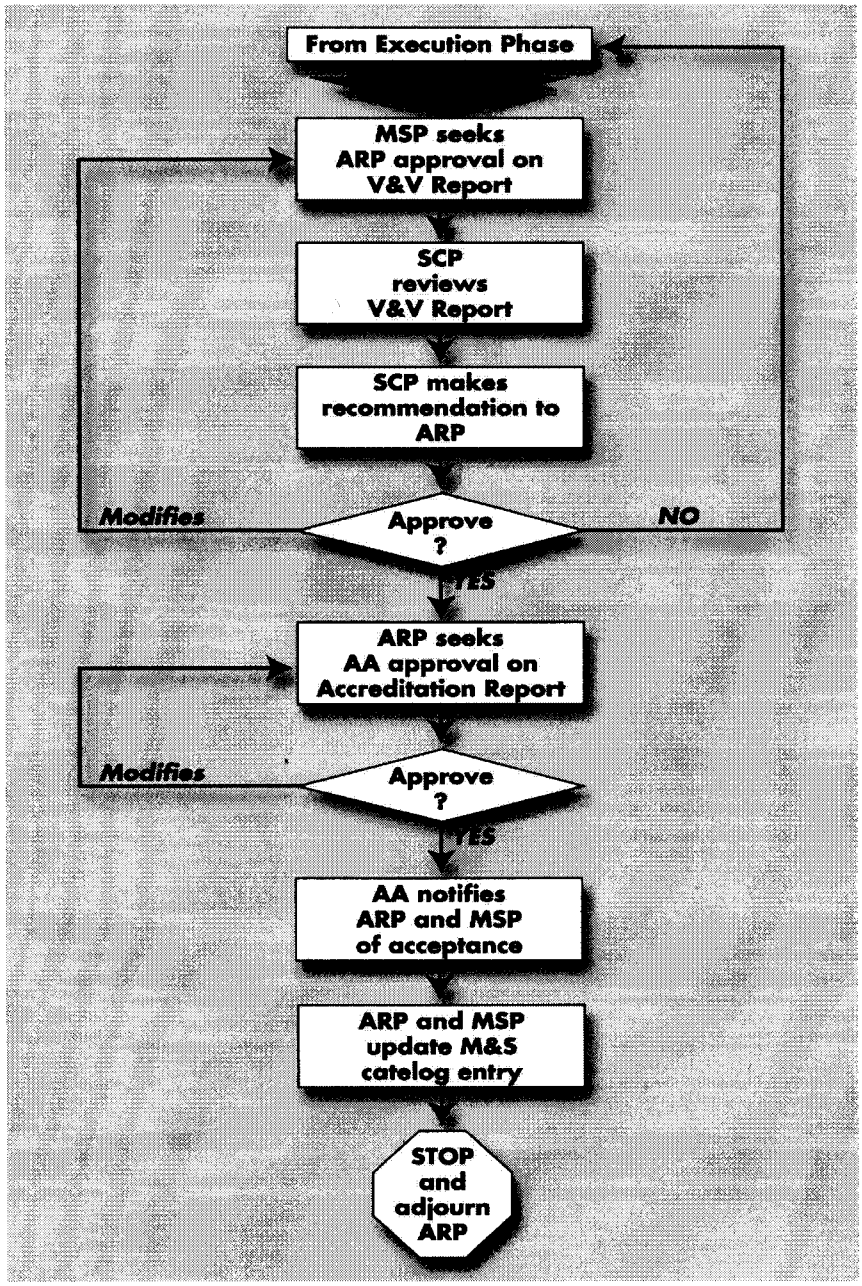

Figure 3: Accreditation Phase

MODELING AND SIMULATION QUALIFICATION CATEGORIES

1. Introduction. Provide a framework for categorizing M&S used to support PEO systems.

2. Modeling and Simulation Qualification. M&S Qualification can be described as a binning process. It is a method for baselining M&S tools used to support PEO systems. Qualification is a means for the Program Managers to establish the varying levels of confidence required by different types of applications. It is a mechanism used to identify and document the level of community acceptance and confidence placed upon a given model. Program Managers may leverage information gained from qualification to support M&S accreditation as necessary. The Program Manager may delegate the authority to qualify M&S to a lower level, such as the systems engineer or project leader.

Qualification is achieved through Program Office assignment of Level of Acceptance to a model. The Acceptance Levels span the spectrum from "unknown by the general community" to "having the model outputs validated against empirical data." Five acceptance levels (0 through 4) are used to specify the degree of confidence, or community acceptance, accorded to a particular model or simulation. Successively higher acceptance levels represent successively greater confidence associated with the qualified M&S generally due to a higher degree of maturity and previous use. The Program Offices will maintain a list of models and simulations and their respective level of acceptance.

Level 0 is the default level specifically applicable to those models and simulations that do not require Program Office scrutiny. This category is used to acknowledge the fact that many models exist with potential application. In general, these models, while useful in a rough order of magnitude sense, will not be applied for critical system/function/performance defining roles. An example of a Level 0 model would be a model used to provide rough estimates of system component weights based upon preliminary design specifications.

Level 1 requires a Subject Matter Expert (SME) approval to determine proper use of a model. The purpose of this category is to properly account for the application of M&S that may provide useful insight into system performance. SME advocacy provides sufficient confidence in these models. For acceptance Level 1, the following limited documentation is required: model or simulation name, proponent, program area that model is

supporting, advocating SME or technical group, and a brief model description.

Level 2 requires M&S to be compared or benchmarked. This is called Registration. Registration is a process of comparing, calibrating, or benchmarking the output of two or more models to ensure consistent results from consistent assumptions and inputs. This is principally an end-result comparison of models and not a detailed comparison of intermediate results or internal calculations. Level 2 documentation includes the same documentation for Level 1, as well as a CM Plan, a Registration Plan, and documented registration results.

Level 3 requires a comprehensive, detailed examination of model components. These models have undergone verification. Verification is the process of determining that a model or simulation implementation accurately represents the developer's conceptual description and specifications. Level 3 documentation includes a CM Plan, a Verification Plan, and documented verification results.

Level 4 requires calibration with empirical data, and represents the highest acceptance level attainable. These models have undergone validation. Validation is the process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended uses of the model. Level 4 documentation includes a CM Plan, a Validation Plan, and documented validation results.

The acceptance levels, although progressive in degree of associated model confidence, do not represent a progression of steps required of any model. Any model, by way of the approved processes, could proceed from Level 0 to any higher level without attaining any intermediate level. Stated another way, there are no prerequisite levels for Levels 1-4. Table 1 represents the M&S Qualification Acceptance Levels that will be used by Program Offices.

TABLE 1: M&S QUALIFICATION ACCEPTANCE LEVELS

Level	Name	Minimum Requirements	Examples
0	Undetermined	♦ No requisite visibility within program ♦ No documentation required	In-house 3-DoF rocket model used for scoping
1	SME Advocacy	♦ SME recommendation ♦ Limited documentation	Footprint Models & Sims used in COEA
2	Registration	♦ Comparison of model results to baseline results ♦ Registration Plan, CM Plan, and documented results required	Engagement Models & Sims used for Trade Studies
3	Verification*	♦ Comprehensive model evaluation relative to its specification ♦ Verification Plan, CM Plan, and documented results required	Simulations used for pre-test predictions
4	Validation*	♦ Comparison of model/sim results to Accredited model/sim results or to empirical data ♦ Validation Plan, CM Plan, and documented results required	Simulations used for valid performance predictions

* Description of V&V activities are provided in reference (e).

LEVELS OF QUALIFICATION ACROSS THE ACQUISITION LIFECYCLE

1. This enclosure provides an example of the levels of qualification of M&S across the acquisition lifecycle.

2. M&S across the Acquisition Lifecycle. Program Managers could use qualification as a means to establish the varying levels of confidence required by different types of applications. Key M&S should be identified as early as possible in a program's lifecycle, but certainly before the Preliminary Design Review (PDR). From these key M&S, "core" M&S should emerge. Core M&S should progressively mature with system design. They become an integral part of program lifecycle management. M&S that are identified as core will be accredited by the Critical Design Review (CDR). Figure 1 below depicts the levels of qualification of M&S across the acquisition lifecycle. The levels depicted refer to the M&S Qualification Acceptance Levels discussed in enclosure (2). The letter "A" refers to points in the acquisition lifecycle where M&S must be accredited to support program reviews (e.g., CDR, MS II, and MS III).

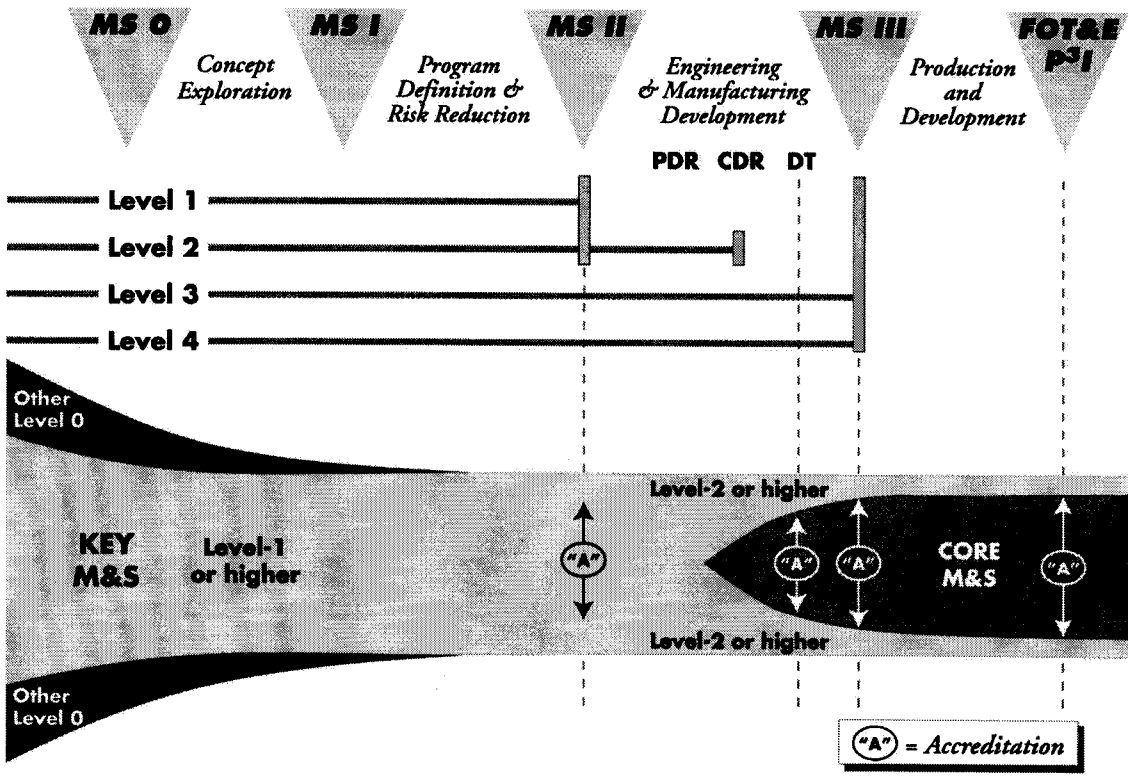

Figure 1: Levels of Qualification of M&S Across the Acquisition Lifecycle

DEFINITIONS

The following definitions are applicable in this instruction.

Accreditation. The official certification that a model or simulation is acceptable for use for a specific purpose.

Accreditation Authority (AA). An individual occupying a position with the appropriate rank, grade, responsibility and/or authority to accredit a model, simulation, or federation of models and/or simulations for a particular purpose or purposes. For design, development, and developmental testing, this authority resides with the Program Managers. For operational testing, this authority resides with the Commander, Operational Test and Evaluation Force.

Accreditation Review Panel (ARP). The PEO Program Office organization responsible for managing the gathering and review of V&V information and presenting an Accreditation Recommendation to the Program Office on all program controlled M&S. It is composed of Program Office representatives and subject matter experts as appropriate. The ARP establishes the SCP.

Core M&S. Those M&S used by a program that are identified by the Program Manager as critical to the design, development test or evaluation of the system or are required to provide critical support to major milestone decisions.

Key M&S. Those M&S used by a program that are not identified as "core" but are determined to be instrumental in supporting system design, development, test, evaluation or major milestone decisions.

Model. A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.

Modeling and Simulation (M&S). The use of models and simulations, including emulators, prototypes, simulators, and stimulators, either statically or over time, to develop data as a basis for making managerial or technical decisions. The terms "modeling" and "simulation" are often interchangeable. References to M&S in this document include hardware in the loop (HWIL) and software in the loop (SWIL).

M&S Application Sponsor. The organization that uses the results/product(s) from a specific application of an M&S.

M&S Proponent (MSP). A developer, maintainer, modifier, user, or sponsor of M&S applied to PEO TSC programs. The MSP provides the required V&V information, conducts V&V activities, and supports the ARP and SCP as tasked.

Qualification. Determination of the level of acceptance (0-4) of a particular model or simulation tool based upon technical community and Program Office confidence.

Simulation. A method for implementing a model over time.

Simulation Control Panel (SCP). A technical review panel established by the ARP to guide the gathering of V&V information. It provides the independent oversight of the execution of the V&V Plan and reviews the V&V efforts of the MSP.

Validation. The process of determining the degree to which a model or simulation is an accurate representation of the real world from the perspective of the intended uses of the model or simulation.

Verification. The process of determining that a model or simulation implementation accurately represents the developer's conceptual description and specification.

ACRONYM LIST

AA	Accreditation Authority
AOA(s)	Analysis of Alternatives
ARP(s)	Accreditation Review Panel(s)
BMDO	Ballistic Missile Defense Organization
CDR	Critical Design Review
CM	Configuration Management
COEA	Cost and Operational Effectiveness Analysis
COMOPTEVFOR	Commander, Operational Test and Evaluation Force
DAB(s)	Defense Acquisition Board
DT	Developmental Test
DT&E	Development Test and Evaluation
DOD	Department of Defense
DON	Department of Navy
FOT&E	Follow-on Operational Test and Evaluation
HWIL	Hardware-In-The-Loop
HIL	Hardware-In-The-Loop
JCS	Joint Chiefs of Staff
JROC	Joint Requirements Oversight Council
JTAMDO	Joint Theater Air and Missile Defense Office
M&S	Modeling and Simulation
MSSC	Modeling Simulation Strategy Council
MSP	Modeling and Simulation Proponent
MSTA	Modeling and Simulation Technical Agent
OSD	Office of the Secretary of Defense
OT	Operational Test
OT&E	Operational Test and Evaluation
PDR	Preliminary Design Review
PPBS	Planning, Programming and Budgeting System
P3I	Pre-Planned Product Improvement
POM	Program Objective Memorandum

SCP(s)	Simulation Control Panels
SME	Subject Matter Expert
SWIL	Software-In-The-Loop
TAMD	Theater Air Missile Defense
TBMD	Theater Ballistic Missile Defense
VV&A	Verification Validation and Accreditation